

REMARKS

Applicants appreciate the thorough review of the present application as reflected in the Official Action mailed March 11, 2005. Applicants have formalized herein their cancellation of Claims 1-12 (without prejudice) in response to the oral Restriction Requirement communicated to Applicants' representative on February 22, 2005. Applicants have also amended each of the pending independent claims in response to the Official Action, and have cancelled Claims 19 and 20. Applicants have also added new Claims 29-42. For the reasons discussed below, Applicants respectfully submit that the claims, as amended, are patentable over the cited references. Accordingly, Applicants respectfully request allowance of each of the pending claims.

I. Applicants Elect Claims 13-28

In response to the Restriction Requirement memorialized in the March 11, 2005 Official Action, **Applicants hereby affirm the provisional election of the claims of Invention II (Claims 13-28)** made orally during a telephone conversation with the Examiner on February 22, 2005. Applicants have canceled the claims drawn to Invention I (Claims 1-12). This cancellation is being done without prejudice to the filing of a divisional application for these claims. Applicants are not traversing the restriction requirement because Applicants agree that unpatentability of the claims of Invention I would not necessarily imply unpatentability of the claims of invention II. The Title has been changed to conform to cancellation of the device claims.

II. The Original Claims, as Amended, Are Patentable Over the Cited Art

Claims 13-18 and 22-25 stand rejected under 35 U.S.C. § 102 as anticipated by U.S. Patent No. 6,339,007 to Wang et al. ("Wang"). (Official Action, p. 3). The remaining claims are rejected under 35 U.S.C. § 103 as being obvious in light of Wang combined with either or both of U.S. Patent No. 6,410,397 to Ochiai et al. and/or U.S. Patent No. 6,590,292 to Kutsunai et al. (Official Action, pp. 5-7). Applicants have amended both of the independent method claims. Claim 13, as amended recites:

13. A method of fabricating a ferroelectric memory device, the method comprising:

forming a lower insulating layer including a conductive plug on a semiconductor substrate;

forming an oxygen-diffusion barrier pattern that is electrically connected to the conductive plug and forming an upper insulating pattern on the lower insulating layer such that the upper insulating pattern surrounds sidewalls of the oxygen-diffusion barrier pattern and a top surface of the upper insulating pattern is higher than a top surface of the oxygen-diffusion barrier pattern;

forming a lower electrode layer on the upper insulating pattern and the oxygen-diffusion barrier pattern;

forming a ferroelectric layer on the lower electrode layer; and

forming an upper electrode layer on the ferroelectric layer;

patterning the lower electrode layer, the ferroelectric layer and the upper electrode layer; and

after forming the upper electrode layer, forming a third insulating layer that directly contacts sidewalls of the patterned lower electrode layer, the patterned ferroelectric layer and the patterned upper electrode layer.

Support for the amendments to Claim 13 can be found, among other places, at pages 12-13 of the specification and Figs. 10-11.

As noted above, Claim 13 stands rejected as anticipated by Wang. Wang is directed to a method of making a capacitor in which a first layer of the lower electrode of the capacitor (layer 24) is deposited directly on a barrier layer 23 using, for example, sputtering. (Wang at Col. 3, lines 47-50 and Fig. 2). A hard mask layer 25 is then formed on the first layer 24 of the lower electrode, and then the barrier layer 23, the first layer 24 of the lower electrode and the hard mask layer 25 are all patterned. (Wang at Col. 3, lines 57-67). Thereafter, an insulating layer 26 is formed to surround the sidewalls of the pattern 23/24/25, and the hard mask pattern 25 is removed. (Wang at Col. 4, lines 1-10). The second layer of the lower electrode 28, the dielectric layer 30 of the capacitor and the upper layer 31 are then sequentially deposited on the first layer 24 of the lower electrode and on the insulating layer 26. (Wang at Col. 4, lines 12-28 and 51-52).

As should be clear from the above, the method of Wang does not disclose or suggest, among other things, the following recitations of Claim 13:

- Patterning the lower electrode layer, the ferroelectric layer and the upper electrode layer after forming the upper electrode layer.
- Forming a third insulating layer that directly contacts sidewalls of the patterned lower electrode layer, the patterned ferroelectric layer and the patterned upper electrode layer.

Accordingly, the rejection of Claim 13 should be withdrawn for at least these reasons.

Applicants also respectfully submit that a skilled artisan would not have been motivated to modify the method of Wang to include patterning the lower electrode layer, the ferroelectric layer and the upper electrode layer and then forming a third insulating layer that directly contacts sidewalls of the patterned lower electrode layer, the patterned ferroelectric layer and the patterned upper electrode layer as recited in Claim 13. This is, for among other reasons, because Wang teaches that a problem with prior art capacitors is "sidewall oxygen diffusion." (Wang at Col. 2, line 6). The capacitor structure of Wang, as described in the "Summary of Invention" is designed so that "dielectric is present on the sidewalls and top of the second electrode portion of the bottom electrode." (Wang at Col. 2, lines 20-22). Wang explains that the invention described therein "protect[s] against side wall diffusion." (Wang at Col. 2, lines 12-15). As such, Wang teaches away from patterning the lower electrode layer, the ferroelectric layer and the upper electrode layer and then forming a third insulating layer that directly contacts sidewalls of the patterned lower electrode layer, the patterned ferroelectric layer and the patterned upper electrode layer as recited in amended Claim 13.

Thus, for each of the above reasons, Applicants respectfully submit that the cited art does not disclose or suggest the invention of amended Claim 13, and that one of skill in the art would not have been motivated to modify the method of the primary reference (Wang) to arrive at the invention of Claim 13, as such modifications would go directly against the teachings of Wang. According, Applicants respectfully submit that Claim 13 is now in condition for allowance.

Applicants have also amended independent Claim 26 to recite that the lower electrode layer is conformally formed directly on both an upper surface of the upper insulating layer and an upper surface of the oxygen-diffusion barrier layer. Claim 26 has further been amended to recite that the patterning of the upper electrode layer, the ferroelectric layer and the lower electrode layer is performed after the upper electrode layer is formed. Wang uses a different technique for patterning parts of the capacitor. Wang likewise teaches away from the electrode/dielectric patterning approach recited in Claim 26 as the dielectric layer of Wang is left on sidewalls of the upper part of the lower electrode, which Wang suggests may protect against sidewall diffusion. (See Wang at Col. 2, lines 10-22). Accordingly, Applicants respectfully submit that Claim 26, as amended, is also patentable over the cited art.

Claims 14-18, 21-25 and 27-28 are patentable at least for the reasons discussed above for which the claims from which they depend are patentable. Accordingly, Applicants respectfully request withdrawal of the rejections of Claims 13, 14-18 and 21-28.

III. The New Claims Are Patentable Over the Cited Art

Applicants have also added new Claims 29-42. Support for each of these claims may be found, for example, in the original disclosure as follows:

- Claims 29, 34 and 42 – Pages 10-11 of the specification and Figs. 10-11 and 18
- Claims 30 and 35 – Pages 10-12 and 15 of the specification and Figs. 9 and 17
- Claims 31 and 36 – Pages 8-9 and 14 of the specification and Figs. 3-5 and 12
- Claims 32 and 37 – Pages 8-9 and 14 of the specification and Figs. 3-5 and 12
- Claim 33 – Original Claim 20
- Claim 38 – Pages 12-13 of the specification and Fig. 11
- Claim 39 – Pages 9-10 of the specification, Figs. 5-6 and 8 and Claim 21
- Claim 40 – See discussion of Claim 13 above
- Claim 41 – See discussion of Claim 26 above

Claims 29-38 depend from either amended Claim 13 or 26, and hence are patentable for each

of the reasons discussed above that the claim from which they depend is patentable over the cited art. In addition, Claims 29-38 are also patentable over the cited art for at least the following additional reasons:

Claims 29 and 34 – Wang does not disclose or suggest depositing a ferroelectric layer directly on only the lower electrode layer. Instead, in Wang the dielectric layer 30 is deposited directly onto both the upper portion of the lower electrode and directly onto the insulating layer 26.

Claims 30 and 36 – Wang teaches using a multi-layer lower electrode consistent with Wang's stated goal of reducing oxygen diffusion through grain boundaries in the lower electrode. (See Wang at Col. 2, lines 3-15).

Claims 31 and 36 – Wang does not disclose or suggest forming a transistor and a capacitor contact pad that electrically connects a source/drain region of the transistor with the conductive plug.

Claims 32 and 37 – Wang does not disclose or suggest forming the lower insulating layer on a first interlayer insulating layer and on the capacitor contact pad and then patterning the lower insulating layer to form a contact hole that exposes a top surface of the capacitor contact pad, and then forming the conductive plug in the contact hole.

Claim 38 – See discussion above with respect to Claim 13.

New independent Claim 39 recites forming one of a class of oxygen-diffusion barrier layers and then forming a hard mask directly on this oxygen diffusion barrier layer. Wang does not disclose or suggest this approach. Claims 40-42 are patentable as depending from a patentable base claim and are independently patentable for the reasons discussed above with respect to claims that include identical recitations.

Thus, for each of the above reasons, new Claims 29-42 are also in condition for allowance.

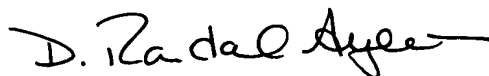
IV. CONCLUSION

For the reasons discussed above, Applicants respectfully submit that the present

In re Heung-Jin Joo et al.
Appl. Serial No. 10/776,394
Filed February 11, 2004
Page 15 of 15

application is in condition for allowance, which action is respectfully requested.

Respectfully submitted,




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